

SCIENCE

NEW YORK, SEPTEMBER 18, 1891.

THE AMERICAN MUSEUM OF ARCHÆOLOGY.

ONE evening early in November, 1889, a company of gentlemen gathered in one of the rooms of the Philadelphia Club, where an elegant dinner was spread. At the head of the table sat Dr. William Pepper, provost of the University of Pennsylvania, and on his right Dr. C. C. Abbot. F. C. Macauley, Esq., sat at the foot of the table, and along the sides were men so distinguished for scientific attainments and public spirit as Professor Edward Cope, Dr. Daniel G. Brinton, Dr. Horace Jayne, the late Dr. Joseph Leidy, and two or three others, — nearly all of them officially connected with the University of Pennsylvania. This institution is not heard of so often in New York and New England as are Columbia, Harvard, and Yale, with all of which, nevertheless, it stands abreast in most particulars. Its library, for example, is one-third larger than that at Harvard.

Up to the date of this merry little feast, which is recalled on account of its results, the University of Pennsylvania had lacked anything to compare with such museums as exist at New Haven and Cambridge, and which not only offer local students of the sciences great facilities, but become centres of original research and asylums for the preservation of valuable material. Thus far in the revival of enthusiasm, which during the past few years has been stirring the alumni and friends of the university, this feature had been neglected; but after the edibles and a part of the potables above-mentioned had disappeared, it was disclosed that these gentlemen had met and dined merely as a pleasant prelude to the discussion of the ways and means of organizing an archæological department and collection in connection with their university.

Dr. Leidy took the chair, the group (excepting Dr. Abbott, to whom these proceedings were all a surprise) resolved itself into a "commission," and in fifteen minutes, promptly and picturesquely, The American Museum of Archæology was in existence.

In the course of the discussion Dr. Abbott was introduced by Dr. Pepper in a speech which reminded his hearers, that, though Dr. Abbott composed books, and had even perpetrated a sonnet now and then, it was not as a poet he was ambitious to shine; that in spite of the fact that he had written the most charming and suggestive books of out-door lore published in America, this work and the attached credit were not foremost in the author's thoughts. Dr. Abbott's chief interest had been from the first in the investigation of the habits, conditions, social advancement, and mental attitude of the American aborigines; and to him science was indebted for valuable contributions in the direction both of materials and of philosophy; while the light which Dr. Abbott had been able to throw upon the antiquity of man in the eastern part of this continent, by his discovery of the stone implements and other traces of paleolithic man in the glacial-drift gravels of the Delaware Valley, had established beyond any reasonable doubt that practically primitive men

had dwelt on these shores during, and prior to, the great glaciation of the northern half of the continent. He asked Dr. Abbott to say what disposition had been made of the great quantities of relics of prehistoric man which he had gathered, and whether the field was exhausted.

Dr. Abbott replied in a speech of some length. He said that his farm near Trenton, N.J., occupied a knoll overlooking wide meadows along the Delaware, which traditionally and evidently had been a favorite resort for the Delaware Indians and for their predecessors. From the ploughed fields and river-banks of this immediate neighborhood he had gathered some 30,000 relics, in stone, bone, and clay, of the aborigines, who had hunted, fished, camped, and manufactured their implements and utensils there. The earlier part of this collection had gone mainly to the Academy of Science at Salem, Mass., and to prominent European archæologists, but since the founding of the Peabody Museum of American Archæology and Ethnology at Cambridge, Mass., everything had been deposited there, where it constitutes the Abbott Collection, embracing 27,000 pieces. This includes the series of paleolithic (drift-gravel) implements and bones. The literary outcome had been many pamphlets and articles, and the book "Primitive Industry," which had summarized the results up to 1881. A new edition of this book is now under way, wherein later investigations will be noted.

The audience was surprised at the magnitude of what one man, with greatly limited means, had been able to accomplish, and regretted that this extremely interesting and valuable material had been taken to a distant museum out of territory which by right was local and belonged to Philadelphia, simply because that city had been too apathetic to obtain and preserve it.

Responding to a further request for advice, Dr. Abbott explained that systematic searching would bring to light a vast quantity more of the same kind of relics in the Delaware Valley, and probably largely extend our present knowledge of the prehistoric inhabitants of that region. He said that large areas of the United States were still unexplored archæologically; that there was abundant room for another organization without duplicating the labors of existing investigators; and that it was of the highest importance that such work should be done at once.

The result was the formation of an Archæological Association under the auspices of the university, the assignment of quarters for the storage and arrangement of materials, and the appointment of Dr. Abbott as curator. Subscriptions were immediately forthcoming for the present needs of the department, and a vigorous and organized effort is beginning for the accumulation of specimens and information, not only, but for the financial endowment necessary to the maintenance of the museum and the attendant instruction and publication of results. Dr. Abbott has consequently severed his official connection with the trustees of the Peabody Museum (who cordially wished him good-speed) and is devoting his energy to the work in this new field. About 25,000 specimens have already been received, and many more are promised as gifts, while the purchase of some small but valuable collections is under way. It is the policy of the

managers, however, to conduct original and intelligent explorations, rather than merely to accumulate a large quantity of "Indian relics" by purchase, and arrangements are now making for the placing of several men in the field who are experts in this kind of scientific work.

Meanwhile the valley of the Delaware is being carefully attended to, and has yielded largely, much material having been collected that throws additional light on the customs and conditions of the Indians that for so many centuries occupied this region. During the summer of 1891 a large number of village sites were exhaustively explored, and two interesting rock shelters examined; while on an island in the river was found an implement maker's work-shop, and a "cache" where 116 beautifully chipped knives, averaging about six inches in length, was brought to light. The flint (jasper) quarry from which the Indians derived their raw material for arrow-heads, knives, scrapers, and drills was also located; the shaft they had sunk examined, and a vast quantity of cores, chips, unfinished implements, and hammers, mauls, and other implement-making tools, were procured.

Recently, through the generosity of several gentlemen, the superb Cope collection was secured, so that even now the museum has excellent facilities for illustrating the conditions of human life on this continent prior to European contact.

The first annual report, a pamphlet with beautiful illustrations, has already appeared, and, better than all else, shows how rapid has been the progress of the venture.

Altogether it appears probable that an institution has been founded which will become not only a source of great local pride and influence in Philadelphia, but will powerfully advance the cause of this most interesting of sciences throughout America. The need of money is great, and the rich men of the country, especially those who are alumni of the University of Pennsylvania, or interested in this part of the country, can find here a use for a portion of their wealth which will be most fruitful in the advancement of knowledge. It is to be hoped, too, that many persons in the Southern and Middle States, who have formed small local collections of archæological specimens, will see the wisdom of depositing them in this general museum, where they can do far more general good than hidden in isolated houses scattered about the country. May every success attend this new museum, and long live Dr. Abbott, its curator.

ERNEST INGERSOLL.

INFLUENCE OF GROUND WATER UPON HEALTH.¹

THE examination of the historic records or of the published mortality tables of this and other countries shows that there are certain conditions which are found to be present when certain diseases are most rife. It is also found, that, after eliminating certain meteorological and other influences which are supposed to affect disease, some particular diseases appear to be solely influenced by the hygrometric condition of the ground and the volume of water which is present in the ground.

In historic periods when particular epidemics have been rife, they have mostly occurred in times of drought, in which it has been established, beyond doubt, by the evidence of the failure of springs and rivers, that the ground water was then exceptionally low.

The actual measurements of the ground water in this country, in some cases, go back for a period beyond that of the registration of deaths, consequently a comparison can be made between the

state of the ground water and the death-rate of any particular period; and when such examination is made it is found that there is a coincidence between the state of the ground water and the deaths recorded. The deaths follow, as a rule, in the inverse ratio, the state of the lowest ground water; that is, high low water indicates a healthy period, while low low water marks the unhealthy periods. Investigations respecting the influence of ground water upon health should be studied over limited areas, as the distribution of rain is often very local, and there are varieties in the geological character of the soil that affect the result of observations carried on over large areas, and on this account, while observations have been carried on by the author over an extended area, he has always used local observations to compare with the mortality returns in the same district, and he has specially dealt with the records of Croydon, which is the place where the observations as to percolation, evaporation, and the hygrometric condition of the soil have been locally studied.

There is every reason to believe that the ground water itself, except when polluted, exercises no influence as a cause of disease, but is merely the measure or indicator of the influences which are at work within a polluted soil, and of certain organic changes which evidently take place within the dark recesses of the soil, and which lead to the development of the conditions favorable to a certain class of disease. That the earth does exercise a baneful effect upon health is well known from the experience in this country of the unhealthfulness of cellar dwellings, and from the fact that persons habitually living upon ground floors are not so healthy as those living in the upper stories of buildings removed from the influence of the ground.

There is a seasonable fluctuation in the waters in the ground, and, as a rule, these waters are lowest in the autumn and early winter, and highest in the spring or early summer; but in some years the period of both low and high water varies, as, for example, the low water of last season did not take place until February of this year (1891).

It is also known that the artificial lowering of the sub-soil waters of a district has produced the same effects upon the health as occurs when a general lowering of the ground water arises naturally from drought.

The actual drying of the ground is a condition which is favorable to the general good health in this country, and this circumstance often masks, in the general death-rate, the potential influence of certain diseases, so that the general health of a district appears to be good, while at the time it may suffer intensely from a certain class of disease of which low ground water is the indicator. When, however, the conditions become extremely intense, and the ground water exceptionally low, the influences at work affect the death-rates as a whole. On the other hand, in periods of excessive rain with high ground water, the conditions are usually favorable to health, and all places in which the ground waters are of a uniform level, such as seaside places, which are governed by the mean tide level, and river valleys with porous soils, like that of the River Wandle, in which the water is headed up to a uniform level by mills, are usually healthy.

It is known that the measure of the effect of the ground water is most marked in districts which draw their water supply from the ground, and amongst that section of the inhabitants who use such water for dietetic and other purposes, especially in the case of young children and teetotallers.

The unhealthy time after the period of excessive low water is that when the first rain begins to percolate through the soil, just as if it washed out matters which had been specially prepared or were retained in the dark recesses of the soil, into the water, or by driving out the ground air specially charged with the poison of disease. It is by no means uncommon both in this and other countries to find that particular epidemic outbreaks which have become rife at a low-water period can be traced to particular rain-falls. In this country since we have the registration of deaths, those quarters of the year when percolation has first commenced after periods of exceptionally low water are, without exception, the most unhealthy seasons that have been recorded. The quarters of the year when percolation first commenced after exceptionally low water have been the most unhealthy, as, for example, the

¹ Abstract of a paper read before the Congress of Hygiene, in London, England, August, 1891, by Baldwin Latham, F.G.S.

March quarters of 1838, 1845, 1847, 1853, 1855, 1864, 1865, 1866, 1875, 1890, 1891, which, with the exception of the third quarter of 1849 (the cholera year), are the most fatal seasons on record.

There is no doubt that the sanitary condition of the district greatly influences the results of the movements of the ground water, and the greater the amount of disturbance or the number of disturbances of the ground water in the course of the season in insanitary districts, the greater and more marked the influence upon health until the period arrives when the soil has been washed free from its impurities, and the waters have accumulated in the ground.

Certain diseases have their allotted seasons and conditions favorable for their development and spread, and there are a number of diseases usually most rife when the ground waters are low, such as enteric fever, cholera, small-pox, diphtheria, and others.

The state of low ground water as being a condition accompanying epidemics of typhoid fever is a matter of constant observation, and it is a well-authenticated fact that all epidemics of this disease in this country have occurred in periods only of low water, or when immediately following a very low state of the ground water.

Ground water influences both small-pox and diphtheria in a most marked manner, but in directly opposite ways, so that when one of these diseases is present the other is absent. Small-pox is accompanied or preceded by intense dryness of the ground, while diphtheria occurs only when the condition of the ground is one of continued dampness. The year 1871 was a very fatal year from small-pox in this country, and in that year the percolation experiments showed that the ground was intensely dry. In 1876 an outbreak of small-pox occurred at Croydon, and continued until the autumn of 1877. Outbreaks of this disease have subsequently occurred in this place in 1881-82 and 1884-85. Since September, 1885, there have been no deaths recorded from small-pox at Croydon, but diphtheria has been very prevalent during the whole of that period, and the ground has been in a constant state of dampness, so much so, that, with the exception of one month, October, 1886, a measurable quantity of water flowed from the percolation gauges every month during all this long period. The last outbreak of small-pox in 1884-85 was preceded by seven months, and that of 1881-82 by five months, when no water percolated through the ground.

Since the time when the author first observed this marked coincidence between the dryness of the ground and outbreaks of small-pox, he has learned from the report of Surgeon-Major G. Hutcheson, M.D., Sanitary Commissioner of the North-western Provinces and Oudh, that the counterpart of this has been observed in India in reference to small-pox, which, it is stated, "is controlled or kept in abeyance by damp and moisture."

The most marked incident in connection with ground water is the remarkable parallelism between the deaths of children under five years of age and the lowness of the ground water; in fact, it is found that the deaths in this case fluctuate inversely in proportion to the volume of the water in the ground.

In 1882 the excess of deaths was no doubt due to the direct pollution of the water-supply of the district. And it should be observed that since 1884 the low waters in this well are lower than would be the case naturally, as since this period the waters have been abnormally lowered by the establishment of the New Croydon Water Works Company's station at Addington. If the deaths from diarrhoea are eliminated as being affected more by temperature than by conditions affecting the state of the ground water, the parallelism between the volume of water in the ground and the death-rate becomes even more marked.

This coincidence between the rates of mortality of children and ground water occurring period after period is tantamount to positive proof that ground water, at least, if not the direct cause, is the measure of the influences at work which seriously menace the lives of young persons.

Those who require further information upon this subject will find it in the author's recent presidential address to the Royal Meteorological Society.

NOTES AND NEWS.

THE *Annals of Hygiene* states that the legislature of Michigan has recently passed a bill making it a misdemeanor, punishable by fine and imprisonment, to manufacture or sell, give or deliver, cigarettes of any kind of tobacco, or cigarette paper in books or blocks for wrapping cigarettes.

— The operations of the Geological Survey of Missouri during the month of August were as follows: Examinations of the zinc and lead deposits have been extended into Greene, Stone, Webster, Howell, Oregon, Carter, Texas, Wright, and Shannon Counties; inspections of iron ores have been made in Cape Girardeau, Bollinger, Wayne, Stoddard, Reynolds, Carter, Ripley, Shannon, and Howell Counties; detailed mapping has been prosecuted in Macon, Chariton, and Henry Counties, and about 70 square miles have been covered. The study of the Quaternary deposits has been continued over the central portion of the State adjacent to the Missouri River; and the mapping of the crystalline rocks has been continued in Madison, St. Francois, Washington, Iron, and Reynolds Counties, as has also the geological mapping in Greene County. For the purpose of constructing models illustrating the conditions of occurrence of ore bodies, detailed surveys have been completed of two important iron deposits. In the laboratory, analyses have been made of clays and iron ores; in the office the plotting of maps preparatory to publication has proceeded uninterruptedly, and work has been continued on the preparation of the report on paleontology. With reference to future work, steps have been taken towards securing for the State the determination of the latitude and longitude of a series of points, which determinations are necessary for the further prosecution of the detailed mapping now in progress.

— Persistent attempts have been made to produce a good artificial substitute for ivory. Hitherto none have been successful. A patent has recently been taken out, says the *Engineer*, for a process based upon the employment of those materials of which natural ivory is composed, consisting, as it does, of tribasic phosphate of lime, calcium carbonate, magnesia, alumina, gelatine, and albumen. By this process, quicklime is first treated with sufficient water to convert it into the hydrate, but before it has become completely hydrated, or "slaked," an aqueous solution of phosphoric acid is poured on to it; and while stirring the mixture the calcium carbonate, magnesia, and alumina are incorporated in small quantities at a time; and lastly the gelatine and albumen dissolved in water are added. The point to aim at is to obtain a compost sufficiently plastic and as intimately mixed as possible. It is then set aside to allow the phosphoric acid to complete its action upon the chalk. The following day the mixture, while still plastic, is pressed into the desired form in moulds, and dried in a current of air at a temperature of about 150° C. To complete the preparation of the artificial product by this process, it is kept for three or four weeks, during which time it becomes perfectly hard. The following are the proportions for the mixture, which can be colored by the addition of suitable substances: quicklime, 100 parts; water, 300 parts; phosphoric acid solution, 1.05 sp. gr., 75 parts; calcium carbonate, 16 parts; magnesia, 1 to 2 parts; alumina, precipitated, 5 parts; gelatine, 15 parts.

— In a paper read before the American Association for the Advancement of Science at the recent meeting in Washington, Professor Joseph James gave the results of a visit to Point Pleasant, Ohio, made to ascertain the age of the rocks. The paper has just been printed in full in the *Journal of the Cincinnati Society of Natural History*. In it is given a notice of such papers as have considered any of the rocks of south-western Ohio to be of earlier age than the Hudson River group of New York. There are also given the details of a section studied by him at Point Pleasant during the summer of 1890. Vanuxem, in 1829, was the first to correlate the Cincinnati strata with the Trenton of New York, and he was followed in this by Conrad in 1841. In 1843 Hall referred the rocks to the Hudson River group of New York. In 1865 Meek and Worthen proposed for the series the name Cincinnati group. This name was generally accepted, but in 1879 a committee of the Cincinnati Society of Natural History advocated abandoning the

term Cincinnati, and substituting Hudson River and Utica slate. The committee also supposed the Trenton was exposed on the Ohio River twenty or twenty-five miles above the city. This opinion was adopted by Professor Orton and others, but Professor James concludes that there is no difference between the lowest beds exposed on the Ohio at Cincinnati and the rocks at Point Pleasant. He says the beds of the two localities cannot be placed in two separate terranes unless an arbitrary line be drawn at some point in the series. The paper is illustrated by two plates of views of the strata at Point Pleasant, and at Ludlow, Ky., opposite Cincinnati.

—A German specialist, Dr. Cold, has recently pleaded for giving young people more sleep. A healthy infant sleeps most of the time during the first weeks, and, in the early years, people are disposed to let children sleep as much as they will. But from six or seven, when school begins, there is a complete change. At the age of ten or eleven the child sleeps only eight or nine hours, when he needs at least ten or eleven, and as he grows older the time of rest is shortened. Dr. Cold believes, according to *Nature*, that up to twenty a youth needs nine hours' sleep, and an adult should have eight or nine. With insufficient sleep, the nervous system, and brain especially, not resting enough, and ceasing to work normally, we find exhaustion, excitability, and intellectual disorders gradually taking the place of love of work, general well-being, and the spirit of initiative.

—An interesting paper upon the slow combustion of explosive gas mixtures (of which *Nature* gives a brief abstract) is contributed to the current number of *Liebig's Annalen* by Dr. Krause and Professor Victor Meyer. The experiments described were made with electrolytic mixtures of hydrogen and oxygen, and denotating mixtures of carbon monoxide and oxygen. The first experiment consisted in heating in a bath of vapor of diphenylamine (305°) a denotating mixture of hydrogen and oxygen contained in a U-shaped tube closed by mercury. The heating was continued without intermission for a fortnight, at the end of which time very little gas remained, almost the whole having slowly combined to form water. The experiment was then repeated in an apparatus constructed entirely of glass, and in which the use of mercury was avoided, except in a small manometer used to indicate the pressure. It was then found that no trace of water was formed at the temperature of diphenylamine vapor (305° C.); at the temperature of boiling sulphur (449°) the amount of combination was exceedingly small; while at 518°, the boiling-point of phosphorus pentasulphide, a considerable amount of combination occurred, but no quantitative rule could be deduced. In all these experiments the gases employed were moist, and no particular care had been taken to remove the last traces of admixed air. Now Bunsen and Roscoe, in their celebrated work on denotating mixtures of hydrogen and chlorine, showed that regular results were only obtained when the film of air condensed upon the surfaces of the glass vessels employed was removed by allowing the gas to stream through the apparatus for several days previous to the experiment. A fresh series of experiments were therefore made, in which these precautions were most rigidly observed; most complicated pieces of apparatus were constructed of glass throughout, which admitted of the drying of the gases prepared (in case of hydrogen and oxygen) by the electrolysis of hot water, so as to exclude ozone and hydrogen peroxide; and the pure gases thus obtained were allowed to stream through the series of bulbs united by capillary tubes for a fortnight, night and day, before the bulbs were sealed off at the capillaries. It was found that, with pure dry gases, scarcely a trace of combination occurred by the fusion of the very fine capillaries. As regards the temperature of ignition of electrolytic hydrogen and oxygen, or denotating carbon monoxide and oxygen, it was found that bulbs containing them do not explode when placed in boiling pentasulphide of phosphorus (518°), but do explode in vapor of stannous chloride (606°). The temperature of ignition lies, therefore, between 518° and 606° C. The mode of explosion differs considerably under different circumstances. In case of explosion in vapor of stannous chloride, the bulb was never shattered, but a sudden appearance of flame within the bulb occurred, accompanied by a slight detonation, and in some cases the

point of the capillary was blown off. It is also astonishing how long one requires to hold such a bulb in a Bunsen flame before explosion occurs; it never occurs until the flame becomes colored yellow, and the glass begins to soften, and frequently only causes a swelling out of the glass at the heated spot. Thin-walled bulbs, however, are sometimes shattered. In two cases it was noticed that the glass at the softened part was violently forced in, owing to the previous heating having caused a large percentage of combination, and hence the production of a partial vacuum. Even after taking the rigid precautions to insure purity above described, no definite quantitative rule connecting the time and percentage of combination has been discovered, experiments performed simultaneously upon similarly treated mixtures yielding widely different results; showing that the irregularities of glass surfaces, even after removal of their air-films, are quite sufficient to modify very sensibly the conditions under which combination occurs.

—The settlement founded by Mrs. Humphry Ward, on the principles laid down in "Robert Elsmere," and which has its home in University Hall, Gordon Square, London, has shown itself intellectually active during the last year, according to the *London Journal of Education*. The warden, the Rev. Philip Wicksteed, M.A., has completed his arrangements for the winter lectures. He will himself undertake a course of lectures on Dante. Mr. Wicksteed has been for some years a university extension lecturer, and is one of the foremost English exponents of Dante. The more immediate ends of the "Robert Elsmere" position will be illustrated by the warden's course on the criticism of the Old Testament. Professor Knight of St. Andrew's, whose Wordsworth studies have earned him a permanent place amongst literary men, will give a series of lectures on "Some Aspects of Theism," a course which will be treated both historically and philosophically. Mr. R. G. Moulton, a university extension lecturer of high reputation, will treat of "The Literary Study of the Bible." The energetic warden will, further, lecture on the "Elements of Political Economy." One of the great difficulties for the ordinary man in the study of economics is the development of the mathematical exposition of the subject. Thus Professor Jevon's "Theory" is founded on mathematics; so, too, the notes and appendices of Professor Marshall's "Economics" are mathematical in treatment. To meet the needs of those whose mathematics are shaky, a class will be held after lectures, so as to enable all to follow, as closely as possible, modern theoretical economics.

—In a lecture on "Old-time Winters in Essex County," delivered before the Essex (Mass.) Institute in May last, Mr. Perley gave interesting particulars on many subjects, including weather, some of which appear in the bulletin of the institute. The lecturer spoke of the watch, church services, dress, food, and schools of the early winter seasons; how the people spent their evenings, the winter employment of the people in cutting off the forests, sledging timber and wood, making pipe staves and barrel hoops, and, most interesting of all, the institution of the old-fashioned shoemakers' shops, of which nearly every farm had one a century ago. Women in those days engaged in spinning and weaving. The holidays were referred to, Thanksgiving, Christmas, and New Year's; and the winter's pleasures, such as sleigh-rides, dancing, spinning and quilting parties, and games, shuffle-board, coasting, skating, trapping, gunning, fishing, singing-schools, and girls' samplers. He also spoke of the old modes of travel, snow-shoes, etc. Nearly all the heavy teaming was done on sleds, and he mentioned the winter of 1768-69, when the travelling was so bad that the farmers in the western part of the State could not get their grain and provisions to the coast to market. Snow remained on the roads as it fell until about a century ago. Mr. Perley then spoke of particular winters: that of 1641-42, when the Indians said they had not seen the ocean so much frozen for forty years; of 1646-47, when there was no snow to lay; of 1696-97, said to be the coldest winter since the first settlement of New England; of 1701-2, which was "turned into summer;" of 1717-18, when the snow was from ten to fifteen feet deep and the drifts twenty-five feet, many one-story houses being buried; of 1740-41, said to be the severest winter known by the settlers, Salem harbor being frozen over as early as October; of 1774-75, a wonderfully mild

winter; of 1779-80, when for forty days, including March, there was no perceptible thaw, and the snow was so hard and deep that loaded teams passed over the fences in any direction, arches being dug under the snow so that men on horseback could ride under them, and which was long remembered as *the* hard winter; of 1784-85, when, as late as April 15, snow was two feet deep, and frozen hard enough to bear cattle; of 1785-86, when in the remarkable storm of Nov. 25, the snow blew into balls, one of which had rolled seventy-six feet, measuring seventeen and a half by twenty-two inches; of 1794-95, when the "Betsey" was launched in Salem on Christmas Day, the thermometer indicating 80° above zero at noon, and men and boys went in swimming; of 1801-2, when the "Ulysses," "Brutus," and "Volutia," three Salem vessels, which sailed out of the harbor on a summer-like morning in February, were all cast away at night on Cape Cod, in a terrible snow-storm, which continued a week. He also referred to more recent seasons, and to the cold winter of 1856-57, when in one week in January was the coldest day by the thermometer ever recorded of late years, mercury in Salem 20° below zero; travel on the railroad between Boston and Salem entirely suspended from Tuesday morning to Thursday afternoon. The recent mild winters were also alluded to.

— At the Bournemouth meeting of the British Medical Association, a discussion on the subject of alcohol was initiated by a paper by Dr. Samuel Wilks. In the course of his paper, as we learn from *Nature*, he stated that he had no acquaintance with any organic changes attributable to alcohol in the lungs and kidneys, but it seemed that the digestive and nervous systems suffered. Physiologists had failed to demonstrate the chemical changes which it underwent in the body, and consequently it was impossible to say whether it was of the nature of a food or not. No one had yet seen a person who lived on alcohol, although there was evidence of persons taking large quantities of alcohol who yet preserved their weight with a minimum of food; and that supported the theory that, although alcohol was not nutritive in itself, it prevented the wear and tear of the body. The opposite theory also existed, that alcohol acted as a spur to the nervous system and quickly wore it out. He could not disapprove of the use of wine and beer, if taken in moderation, by the masses of the people; but as to spirits, or spirits and water, he had not made up his mind that they were in any way useful, and he seldom recommended them. Dr. Bucknill thought that the wise use of wine might cure some cases and be useful in others. Dr. Norman Kerr said that alcohol was a poison, analogous in many respects to other poisons: Sir Risdorn Bennett agreed with Dr. Wilks in not approving of spirits as a beverage. He believed it to be useful in fever and in some nervous diseases, but he did not think it desirable at the present time to lay down any broad principles with regard to alcohol with reference to the whole community.

— In the hamlet of Sewardstone, England (as we learn from *Amateur Gardening*), Mr. W. Melles, J.P., the leading landowner in the district, has, at his own expense, supplied and planted a collection of apples, pears, plums, cherries, and bush fruits for the purpose of enabling the principles of fruit culture to form part of the educational curriculum at the Sewardstone Board School. The collection embraces all the most useful varieties, and the trees are planted in such a manner that they form a border of some width to the spacious playground. The boys and girls will share in the work of attending to the culture of these trees, and on certain days the head master, Mr. Spink, who is an enthusiast on the subject, will give lessons on theory and practice. Mr. Spink has drawn up a graduated scheme for teaching fruit culture as a specific subject to his scholars, and this is being submitted to the inspectors for their approval, so that the children may in due course be examined thereon. According to Mr. Spink's scheme, the children will first be taught the botany of an apple blossom and fruit, followed by difference between seedling and parent, planting, mulching, summer and winter pruning, thinning the fruit, insect pests, packing, and storing the fruit: this will constitute the first stage. The second stage will deal with the food of fruit trees, manures, course of sap; and the third, the art of propagation. The first stage in the scheme covers a variety of

subjects, but Mr. Spink has been obliged to do this because most of the boys leave the schools when they have passed the fifth standard, and hence it is needful to let them know as much of the first stage as possible before they do so. This is an excellent idea, and one which might be followed with advantage by other schools in country districts. "The exterior walls of schools might be turned to good account for growing peaches, apricots, and the finer kinds of pears and plums. If the head master could not undertake the practical management of such trees, some of the gentlemen who reside in the parish would, in such a case, be doing an excellent service by allowing their gardener to pay occasional visits, and advise, as well as give practical illustrations of the systems of pruning, disbudding, etc. If the correct principles of fruit culture could only be firmly instilled in the minds of boys and girls when at school, they would grow up into men and women armed with information that would, whether as servants or masters, be of the greatest possible value to them and to the welfare of the country generally."

— The *Photographic News* says that the great progress that has been made in the methods by which rapid movements can be analyzed is well seen in a series of photographs lately taken by Anchütz of Lissa, who has already given to the world some of the best instantaneous pictures ever taken. The subject of the pictures at present under consideration is a dog jumping over a small bush. In the act of making one jump the animal has been photographed twenty-four separate times, and each picture is not a mere silhouette, as was the case with Muybridge's first attempts of this kind, but a little picture showing half-tone and detail. Some of the attitudes are, of course, comic in appearance, for they represent phases of a movement which the eye is unaccustomed to, and cannot possibly appreciate. Notably is this the case in the commencement of the jump, when the dog's hind toes only touch the ground; and again at the finish of the jump, when his legs are gathered together in a heap.

— We have received from Mr. Mostyn, says *Nature*, an interesting letter on the well-known appearance of the green ray at sunrise or sunset caused by the refraction of the air. He states: "This 'green ray' is seen to best advantage at sun-rise, owing, I imagine, to the eye not being wearied with watching the previous glare, as is apt to be the case at sunset. At the same time, I had many very satisfactory observations at sunset, one in particular, when we were running before a very heavy sea in the Southern Ocean, and the 'green ray' was seen no less than three times in as many seconds, as the ship rose and fell on the huge waves, causing as it were two sunsets, with a sunrise between them. The best displays took place when the refraction near the horizon was of such a character that the sun assumed a balloon, or vase, shape as he came close to the sea-line. When, on the contrary, the sun appeared flattened out in its horizontal diameter, the 'green ray' was either entirely absent, or was seen only in an indistinct and uncertain manner."

— Public interest in industrial and commercial exhibitions will doubtless be somewhat stimulated this year by the extensive preparations now making for the World's Columbian Exhibition at Chicago. Among the many attractions of this kind offered to the public, and presenting valuable opportunities to inventors and artisans ready to invite attention to their work, perhaps there are none which have a longer or more useful record than the annual fairs of the American Institute of this city. The sixtieth exhibition of the institute will open this year on Sept. 30, and continue in operation until Nov. 28, giving two months' time to exhibitors improving the full period. The general superintendent, Mr. Charles Wager Hull, is ready at the offices of the institute, No. 113 West 38th Street, to give information and receive applications for space. The fair will be held in the Exhibition Hall on Third Avenue, which is now open for the reception of machinery. Other exhibits will be received on and after the 21st. The entries for the forthcoming exhibition already show a continued interest in the American Institute, and indicate that the exhibition of the present year will be in no respect less successful than its many predecessors.

SCIENCE:

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE QUESTION OF A TABLE AT THE NAPLES STATION.

At present, as we learn from a statement recently made by Professor Sclater in *Nature*, the zoological station at Naples rents continuously about twenty tables, each at \$500 a year. These tables are rented to different States and universities of Europe, as follows: Prussia, 4; Baden, 1; Bavaria, 1; Saxony, 1; Hesse, 1; Wurtemberg, 1; Italy, 7; Switzerland, 1; Hungary, 1; Holland, 1; University of Cambridge (England), 1; British Association, 1. Besides these twenty-one regular rents, a number of others, varying from eight to sixteen, are made every year to some or all of the following governments: Russia, Belgium, Austria, Spain, and some Italian provincial governments. The average number disposed of in this way is estimated at ten, making the total number thirty-one. The annual income from tables would thus amount to about \$15,000 a year. The revenue from the sale of preserved specimens amounts to about \$3,500, while the receipts from the admission of visitors to the aquarium amounts to about \$5,000. The whole income is thus approximately \$24,000. But the annual expenditure of the station has now reached \$32,000, so that there is a deficit of from \$8,000 to \$10,000 to meet. This heavy deficit is met every year by a subsidy from the German government. "This is a good example," says Professor Sclater, "of the liberal way in which science is encouraged and supported in the 'Fatherland,' and is the more noteworthy because the object of its well-bestowed bounty in this instance is localized on foreign soil."

Indeed, this is a splendid example of the high appreciation in which pure scientific research is held by an enlightened government — an example which we should be glad to see followed in this country.

But what interest has America taken in the Naples station? With the single exception of Williams College, which

rented a table for one year, our colleges and universities have contributed nothing towards maintaining this magnificent establishment. A considerable number of American zoologists have been permitted to occupy tables at the station, free of charge, through the generous courtesy of its director and founder, Dr. Dohrn. While we have been the recipients of such exceptional favors for some ten or fifteen years, we have thus far, for some reason or no reason, failed to take any decided action towards securing a permanent table. During the past year a table has been supported through the liberality of Maj. Alex. Henry Davis of Syracuse, and the hope has been entertained that the praiseworthy initiative of Maj. Davis would lead, in one way or other, to the continued maintenance of an American table. The matter was brought before the American Association for the Advancement of Science, at its recent session in Washington, by Dr. Stiles, and the association responded to the appeal by offering to contribute \$100 towards the subscription. This leaves \$400 to be obtained elsewhere. It is a pity that the American Association could not, as the British Association does, take a whole table instead of one-fifth of a table. Possibly at the next session the association may be able to increase its offer to the full subscription, and thus one table be secured, so that the American student who goes to Naples for biological study will not have to feel the long-standing reproach that his country has done nothing to support the only international biological station in existence. Meanwhile the question arises, shall we not try to raise at once the amount required for a table this year? As one of our morphologists desires to spend the winter in embryological research at Naples, and as we have already placed ourselves under repeated obligation to the station, it seems that immediate action ought to be taken, and I most heartily approve of the effort of Dr. Stiles to procure by subscription the needed sum.

The only objection — if such it is worthy to be called — likely to arise is that we have pressing home needs that might be said to claim first attention. But great and urgent as these needs unquestionably are, I see no reason to suppose that we should reach them sooner by neglecting a plain duty to the Naples station. On the contrary, I believe that the national interest which some of us have most at heart is so intimately related to the international interest, that what we accomplish for the one will redound to the good of the other.

Perhaps a movement in behalf of the Naples station may encounter a little national prejudice, or possibly a narrower feeling that is still more foreign to the catholicity of a scientific brotherhood.

The sentiment to which Dr. Dohrn gave expression in a recent number of *Nature* deserves to be repeated here. "I think," says Dr. Dohrn, "the time has come when one must raise one's voice most distinctly against the narrowing limits of national prejudice, which nowadays has grown to almost overwhelming and even pernicious importance in many provinces of material, and — I am sorry to say — also moral and intellectual existence. Science at any rate ought to be exempt from that morbid exclusiveness which refuses to act in rational community regardless of political or ethnographical boundaries."

C. O. WHITMAN.

"THE Century Dictionary" is at last completed; the sixth and concluding volume will soon be brought out, the final pages being now on the press. The work contains about 500 more pages and 2,000 more illustrations than were originally promised.

ENDOWED RESEARCH IN PHYSICS.¹

THERE is a subject which has long been in my mind, and which I determined to bring forward whenever I had a cathedral opportunity of doing so; and now, if ever, is a suitable occasion. It is to call attention to the fact that the further progress of physical science in the somewhat haphazard and amateur fashion in which it has been hitherto pursued in this country is becoming increasingly difficult, and that the quantitative portion especially should be undertaken in a permanent and publicly-supported physical laboratory on a large scale. If such an establishment were to weaken the sinews of private enterprise and individual research it should be strenuously opposed; but, in my opinion, it would have the opposite effect, by relieving the private worker of much which he can only with great difficulty, sacrifice, and expense, undertake. To illustrate more precisely what I mean, it is sufficient to recall the case of astronomy. The amateur astronomer has much work lying ready to his hand, and he grapples with it manfully. To him is left the striking out of new lines and the guerilla warfare of science. Skirmishing and brilliant cavalry evolutions are his natural field; he should not be called upon to take part in the general infantry advance. It is wasting his energies, and he could not do it in the long run well. What, for instance, would have been the state of astronomy — the nautical almanac department of astronomy — without the consecutive and systematic work of the National Observatory at Greenwich? It may be that some enthusiastic amateurs would have devoted their lives to this routine kind of work, and here at one time and there at another a series of accurate observations would have been kept for several years. Pursued in that way, however, not only would the effort be spasmodic and temporary, but the energy and enthusiasm of those amateurs would have been diverted from the pioneering more suited to them, and have been cramped in the groove of routine, eminently adapted to a permanent official staff, but not wholesome for an individual.

Long-continued consecutive observations may be made by a leader of science, as functions may be tabulated by an eminent mathematician; but if the work can be done almost equally well (some would say better) by a professional observer or computator, how great an economy results.

Now all this applies equally to physics. The ohm has been determined with 4-figure, perhaps with 5-figure, accuracy; but think of the list of eminent men to whose severe personal labor we owe this result, and ask if the spoil is worth the cost. Perhaps in this case it is, as a specimen of a well-conducted determination. We must have a few specimens, and our leaders must show us the way to do things. But let us not continue to use them for such purposes much longer. The quest of the fifth or sixth decimal is a very legitimate, and may become a very absorbing, quest, but there are plenty of the rank and file who can undertake it if properly generalised and led; not as isolated individuals, but as workers in a National Laboratory under a competent head and a governing committee. By this means work far greater in quantity, and in the long run more exact in quality, can be turned out, by patient and conscientious labor without much genius, by the gradual improvement of instrumental means, by the skill acquired by practice, and by the steady drudgery of routine. Paris has long had one form of such an institution, in the Conservatoire des Arts et Métiers, and

has been able to impose the metric system on the civilized world in consequence. It can also point to the classical determinations of Regnault as the fruits of just such a system. Berlin is now starting a similar or a more ambitious scheme for a permanent national physical institute. Is it not time that England, who in physical science, I venture to think, may in some sort claim a leading place, should be thinking of starting the same movement?

The Meteorological and Magnetic Observatory at Kew (in the inauguration of which this association took so large a part) is a step, and much useful quantitative work is done there. The new Electric Standardizing Laboratory of the Board of Trade is another, and, in some respects perhaps, a still closer approximation to the kind of thing I advocate. But what I want to see is a much larger establishment erected on the most suitable site, limited by no specialty of aim nor by the demands of the commercial world, furnished with all appropriate appliances, to be amended and added to as time goes on and experience grows, and invested with all the dignity and permanence of a national institution: a physical laboratory, in fact, precisely comparable to the Greenwich observatory, and aiming at the very highest quantitative work in all departments of physical science. That the arts may be benefitted may be assumed without proof. It is largely the necessity of engineers that has inspired the amount of accuracy in electrical matters already attained. The work and appliances of the mechanical engineer eclipse the present achievements of the physicist in point of accuracy, and it is by the aid of the mechanician and optician that precision even in astronomy has reached so high a stage. There is no reason why physical determinations should be conducted in an amateur fashion, with comparatively imperfect instruments, as at present they mostly are. Discoveries lie along the path of extreme accuracy, and they will turn up in the most unexpected way. The aberration of light would not have been discovered had not Bradley been able to measure to less than 1 part in 10,000; and what a brilliant and momentous discovery it was! He was aiming at the detection of stellar parallax. This is the type of result which sometimes lurks in the fifth decimal, and which confers upon it an importance beside which the demands of men who wish to serve the taste and the pocket of the British public sink into insignificance.

In a national observatory accuracy should be the one great end; the utmost accuracy in every determination that is decided on and made. Only one thing should be more thought of than the fifth significant figure, and that is the sixth. The consequences flowing from the results may safely be left; such as are not obvious at once will distil themselves out in time. And the great army of outside physicists, assured of the good work being done at headquarters, will (to speak again in astronomical parable) cease from peddling with taking transits or altitudes, and will be free to discover comets, to invent the spectroscope, to watch solar phenomena, to chemically analyze the stars, to devise celestial photography, and to elaborate still more celestial theories; all of which novelties in their maturity may be handed over to the national observatory, to be henceforth incorporated with, and made part of, its routine life; leaving the advance guard and skirmishers free to explore fresh territory, secure in the knowledge that what they have acquired will be properly surveyed, mapped, and utilized, without further attention from them.

As to the practical applications, they may in any case be left to take care of themselves. The instinct of humanity in

¹ Abstract of an address before the section of Mathematics and Physics of the British Association for the Advancement of Science, at Cardiff, August, 1891, by Professor Oliver J. Lodge, president of the section (*Nature*, Aug. 20).

this direction, and the so-called solid gains associated with practical achievements, will always secure a sufficient number of acute and energetic workers to turn the new territory into arable land and pasture adapted to the demands of the average man. The labor of the agriculturist in rendering soil fertile is, of course, beyond praise; but it is not the work of the pioneer. As Mr. Huxley eloquently put it, when contrasting the application of science with the advance of science itself, speaking of the things of commercial value which the physical philosopher sometimes discovers: "Great is the rejoicing of those who are benefitted thereby, and, for the moment, science is the Diana of all the craftsmen. But even while the cries of jubilation resound, and the flotsam and jetsam of the tide of investigation is being turned into the wages of workmen and wealth of capitalists, the crest of the wave of scientific investigation is far away on its course over the illimitable ocean of the unknown."

I have spoken of the work of the national laboratory as devoted to accuracy. It is hardly necessary to say that it will be also the natural custodian of our standards, in a state fit for use and for comparison with copies sent to be certified. Else perhaps some day our standard ohm may be buried in a brick wall at Westminster, and no one living may be able to recall precisely where it is.

But, in addition to these main functions, there is another, equally important with them, to which I must briefly refer. There are many experiments which cannot possibly be conducted by an individual, because forty or fifty years is not long enough for them. Secular experiments on the properties of materials—the elasticity of metals, for instance; the effect of time on molecular arrangement; the influence of long exposure to light, or to heat, or to mechanical vibration, or to other physical agents.

Does the permeability of soft iron decay with age, by reason of the gradual cessation of its ampèrian currents? Do gases cool themselves when adiabatically preserved, by reason of imperfect elasticity or too many degrees of freedom of their molecules? Unlikely, but not impossible. Do thermoelectric properties alter with time? And a multitude of other experiments which appear specially applicable to substances in the solid state—a state which is more complicated, and has been less investigated, than either the liquid or the gaseous; a state in which time and past history play an important part.

Whichever of these long researches requires to be entered on, a national laboratory, with permanent traditions and a continuous life, is undoubtedly the only appropriate place. At such a place as Glasgow the exceptional magnitude of a present occupant may indeed inspire sufficient piety in a successor to secure the continuance of what has been there begun; but in most college laboratories, under conditions of migration, interregnum, and a new *régime*, continuity of investigation is hopeless.

I have at any rate said enough to indicate the kind of work for which the establishment of a well-furnished laboratory with fully equipped staff is desirable, and I do not think that we, as a nation, shall be taking our proper share of the highest scientific work of the world until such an institution is started on its career.

There is only one evil which, so far as I can see, is to be feared from it: if ever it were allowed to impose on outside workers as a central authority, from which infallible dicta were issued, it would be an evil so great that no amount of good work carried on by it could be pleaded as sufficient mitigation.

If ever by evil chance such an attitude were attempted, it must rest with the workers of the future to see that they permit no such shackles; for if they are not competent to be independent, and to condemn the voice of authority speaking as mere authority, if their only safeguard lies in the absence of necessity for struggle and effort, they cannot long hope to escape from the futility which surely awaits them in other directions.

I am thus led to take a wider range, and, leaving temporary and special considerations, to speak of a topic which is as yet beyond the pale of scientific orthodoxy, and which I might, more wisely, leave lying by the roadside. I will, however, take the risk of introducing a rather ill-favored and disreputable looking stranger to your consideration, in the belief—I might say, in the assured conviction—that he is not all scamp, and that his present condition is as much due to our long-continued neglect as to any inherent incapacity for improvement in the subject.

I wish, however, strenuously to guard against its being supposed that this association, in its corporate capacity, lends its countenance to, or looks with any favor on, the outcast. What I have to say—and, after all, it will not be much—must rest on my own responsibility. I should be very sorry for any adventitious weight to attach to my observations on forbidden topics from the accident of their being delivered from this chair. The objection to which I have now hinted is the only one that seems to have any just weight, and on all other counts I am willing to incur such amount of opprobrium as naturally attaches to those who enter on a region where the fires of controversy are not extinct, and in which it is quite impossible, as well as undesirable, for every one to think alike.

It is but a platitude to say that our clear and conscious aim should always be truth, and that no lower or meaner standard should ever be allowed to obtrude itself before us. Our ancestors fought hard and suffered much for the privilege of free and open inquiry, for the right of conducting investigations untrammelled by prejudice and foregone conclusions, and they were ready to examine into any phenomenon which presented itself. This attitude of mind is perhaps necessarily less prominent now, when so much knowledge has been gained, and when the labors of many individuals may be rightly directed entirely to its systematization and a study of its inner ramifications; but it would be a great pity if a too absorbed attention to what has already been acquired, and to the fringe of territory lying immediately adjacent thereto, were to end in our losing the power of raising our eyes and receiving evidence of a totally fresh kind, of perceiving the existence of regions into which the same processes of inquiry as had proved so fruitful might be extended, with results at present incalculable and perhaps wholly unexpected. I myself think that the ordinary processes of observation and experiment are establishing the existence of such a region; that, in fact, they have already established the truth of some phenomena not at present contemplated by science, and to which the orthodox man shuts his ears.

For instance, there is a question whether it has or has not been established by direct experiment that a method of communication exists between mind and mind irrespective of the ordinary channels of consciousness and the known organs of sense, and, if so, what is the process. It can hardly be through some unknown sense organ, but it may be by some direct physical influence on the ether, or it may be in some still more subtle manner. Of the process I as yet

know nothing. For brevity it may be styled "thought-transference," though the name may turn out to be an unsuitable one after further investigation. Further investigation is just what is wanted. No one can expect others to accept his word for an entirely new fact, except as establishing a *prima facie* case for investigation.

But I am only now taking this as an instance of what I mean; whether it be a truth or a fiction, there is not, I suppose, one of the recognized scientific societies who would receive a paper on the subject. (This, however, is mere conjecture. I am not aware that the experiment has been tried.) There are individual scientific men who have investigated these matters for themselves; there are others who are willing to receive evidence, who hold their minds open and their judgment in suspense; but these are only individuals. The great majority, I think I am right in saying, feel active hostility to these researches and a determined opposition to the reception or discussion of evidence. And they feel this confirmed scepticism, as they call it, not after prolonged investigation, for then it might be justified, but sometimes after no investigation at all. A few tricks at a public performance, or the artifices of some impostor, and they decline to consider the matter further.

That individuals should take this line is, however, natural enough; they may be otherwise occupied and interested. Everybody is by no means bound to investigate everything; though, indeed, it is customary in most fields of knowledge for those who have kept aloof from a particular inquiry to defer in moderation to those who have conducted it, without feeling themselves called upon to express an opinion. Some there are, no doubt, who consider that they have given sufficient time and attention to the subject with only negative results. Their evidence is, of course, important; but plainly, negative evidence should be of immense bulk and weight before it can outweigh even a moderate amount of positive evidence. However, it is not of the action of individuals that I wish to speak, it is of the attitude to be adopted by scientific bodies in their corporate capacity; and for a corporate body of men of science, inheritors of the hard-won tradition of free and fearless inquiry into the facts of nature untrammelled by prejudice, for any such body to decline to receive evidence laboriously attained and discreetly and inoffensively presented by observers of accepted competency in other branches, would be, if ever actually done and persisted in, a terrible throwing away of their prerogative, and an imitation of the errors of a school of thought against which the struggle was at one time severe.

In the early days of the Copernican theory, Galileo for some years refrained from teaching it, though fully believing its truth, because he considered that he had better get more fully settled in his university chair before evoking the storm of controversy which the abandonment of the Ptolemaic system would arouse. The same thing in very minor degree is going on to-day. I know of men who hesitate to avow interest in these new investigations (I do not mean credence — the time is too early for avowing credence in any but the most rudimentary and definitely ascertained facts — but hesitate to avow interest) until they have settled down more securely and made a name for themselves in other lines. Caution and slow progress are extremely necessary; fear of avowing interest or of examining into orthodox facts is, I venture to say, not in accordance with the highest traditions of the scientific attitude.

We are, I suppose, to some extent afraid of each other, but we are still more afraid of ourselves. We have great

respect for the opinions of our elders and superiors; we find the matter distasteful to them, so we are silent. We have, moreover, a righteous mistrust of our own powers and knowledge; we perceive that it is a wide region extending into several already cultivated branches of science, that a many-sided and highly-trained mind is necessary adequately to cope with all its ramifications, that in the absence of strict inquiry imposture has been rampant in some portions of it for centuries, and that unless we are preternaturally careful we may get led into quagmires if we venture on it at all.

Now let me be more definite, and try to state what this field is, the exploration of which is regarded as so dangerous. I might call it the borderland of physics and psychology. I might call it the connection between life and energy; or the connection between mind and matter. It is an intermediate region, bounded on the north by psychology, on the south by physics, on the east by physiology, and on the west by pathology and medicine. An occasional psychologist has groped down into it and become a metaphysician. An occasional physicist has wandered up into it and lost his base, to the horror of his quondam brethren. Biologists mostly look at it askance, or deny its existence. A few medical practitioners, after long maintenance of a similar attitude, have begun to annex a portion of its western frontier. The whole region seems to be inhabited mainly by savages, many of them, so far as we can judge from a distance, given to gross superstition. It may, for all I know, have been hastily traversed, and rudely surveyed by a few clear-eyed travellers; but their legends concerning it are not very credible, certainly are not believed.

Why not leave it to the metaphysicians? I say it has been left to them long enough. They have explored it with insufficient equipment. The physical knowledge of the great philosophers has been necessarily scanty. Men of genius they were, and their writings may, when interpreted, mean much. But to us, as physicists, they are unsatisfactory; their methods are not our methods. They may be said to have floated a balloon over the region with a looking-glass attached, in which they have caught queer and fragmentary glimpses. They may have seen more than we give them credit for, but they appear to have guessed far more than they saw.

Our method is different. We prefer to creep slowly from our base of physical knowledge, to engineer carefully as we go, establishing forts, making roads, and thoroughly exploring the country, making a progress very slow, but very lasting. The psychologists from their side may meet us. I hope they will; but one or other of us ought to begin.

A vulnerable spot on our side seems to be the connection between life and energy. The conservation of energy has been so long established as to have become a commonplace. The relation of life to energy is not understood. Life is not energy, and the death of an animal affects the amount of energy no whit; yet a live animal exerts control over energy which a dead one cannot. Life is a guiding or directing principle, disturbing to the physical world but not yet given a place in the scheme of physics. The transfer of energy is accounted for by the performance of work; the guidance of energy needs no work, but demands force only. What is force? and how can living beings exert it in the way they do? An automaton worked by preceding conditions, that is, by the past, say the materialists. Are we so sure that they are not worked by the future too? In other words, that the totality of things, by which every one must admit that actions are guided, includes the future as well as the

past, and that to attempt to deduce those actions from the past only will prove impossible. In some way matter can be moved, guided, disturbed, by the agency of living beings; in some way there is a control, a directing-agency active, and events are caused at its choice and will that would not otherwise happen.

A luminous and hopeful idea is that time is but a relative mode of regarding things; we progress through phenomena at a certain definite pace, and this subjective advance we interpret in an objective manner, as if events necessarily happened in this order and at this precise rate. But that may be only one mode of regarding them. The events may be in some sense existent always, both past and future, and it may be we who are arriving at them, not they which are happening. The analogy of a traveller in a railway train is useful. If he could never leave the train nor alter its pace, he would probably consider the landscapes as necessarily successive, and be unable to conceive their co-existence.

The analogy of a solid cut into sections is closer. We recognize the universe in sections, and each section we call the present. It is like the string of slices cut by a microtome; it is our way of studying the whole. But we may err in supposing that the body only exists in the slices which pass before our microscope in regular order and succession.

We perceive, therefore, a possible fourth-dimensional aspect about time, the inexorableness of whose flow may be a natural part of our present limitations. And if once we grasp the idea that past and future may be actually existing, we can recognize that they may have a controlling influence on all present action, and the two together may constitute "the higher plane," or the totality of things, after which, as it seems to me, we are impelled to seek, in connection with the directing of force or determinism, and the action of living beings consciously directed to a definite and preconceived end.

Inanimate matter is controlled by the *vis a tergo*; it is operated on solely by the past. Given certain conditions, and the effect in due time follows. Attempts have been made to apply the same principle to living and conscious beings, but without much success. These seem to work for an object, even if it be the mere seeking for food; they are controlled by the idea of something not yet palpable. Given certain conditions, and their action cannot certainly be predicted; they have a sense of option and free will. Either their actions are really arbitrary and indeterminate, which is highly improbable, or they are controlled by the future as well as by the past. Imagine beings thus controlled: automata you may still call them, but they will be living automata, and will exhibit all the characteristics of live creatures. Moreover, if they have a merely experiential knowledge, necessarily limited by memory and bounded by the past, they will be unable to predict each other's actions with any certainty, because the whole of the data are not before them. May not a clearer apprehension of the meaning of life and will and determinism be gradually reached in some such direction as this?

By what means is force exerted, and what, definitely, is force? I can hardly put the question here and now so as to be intelligible, except to those who have approached and thought over the same difficulties; but I venture to say that there is here something not provided for in the orthodox scheme of physics; that modern physics is not complete, and that a line of possible advance lies in this direction.

I might go further. Given that force can be exerted by an

act of will, do we understand the mechanism by which this is done? And if there is a gap in our knowledge between the conscious idea of a motion and the liberation of muscular energy needed to accomplish it, how do we know that a body may not be moved without ordinary material contact by an act of will? I have no evidence that such a thing is possible. I have tried once or twice to observe its asserted occurrence, and failed to get anything that satisfied me. Others may have been more fortunate. In any case, I hold that we require more knowledge before we can deny the possibility. If the conservation of energy were upset by the process, we should have grounds for denying it; but nothing that we know is upset by the discovery of a novel medium of communication, perhaps some more immediate action through the ether. It is no use theorizing; it is unwise to decline to examine phenomena because we feel too sure of their impossibility. We ought to know the universe very thoroughly and completely before we take up that attitude.

Again, it is familiar that a thought may be excited in the brain of another person, transferred thither from our brain, by pulling a suitable trigger; by liberating energy in the form of sound, for instance, or by the mechanical act of writing, or in other ways. A prearranged code called language, and a material medium of communication, are the recognized methods. May there not also be an immaterial (perhaps an ethereal) medium of communication? It is possible that an idea can be transferred from one person to another by a process such as we have not yet grown accustomed to, and know practically nothing about? In this case I have evidence. I assert that I have seen it done, and am perfectly convinced of the fact. Many others are satisfied of the truth of it too. Why must we speak of it with bated breath, as of a thing of which we are ashamed? What right have we to be ashamed of a truth?

And after all, when we have grown accustomed to it, it will not seem altogether strange. It is, perhaps, a natural consequence of the community of life or family relationship running through all living beings. The transmission of life may be likened in some ways to the transmission of magnetism, and all magnets are sympathetically connected, so that, if suitably suspended, a vibration from one disturbs others, even though they be distant ninety-two million miles.

It is sometimes objected that, granting thought-transference or telepathy to be a fact, it belongs more especially to lower forms of life, and that as the cerebral hemispheres develop we become independent of it; that what we notice is the relic of a decaying faculty, not the germ of a new and fruitful sense; and that progress is not to be made by studying or attending to it. It may be that it is an immature mode of communication, adapted to lower stages of consciousness than ours, but how much can we not learn by studying immature stages? As well might the objection be urged against a study of embryology. It may, on the other hand, be an indication of a higher mode of communication, which shall survive our temporary connection with ordinary matter.

I have spoken of the apparently direct action of mind on mind, and of a possible action of mind on matter. But the whole region is unexplored territory, and it is conceivable that matter may react on mind in a way we can at present only dimly imagine. In fact, the barrier between the two may gradually melt away, as so many other barriers have done, and we may end in a wider perception of the unity of nature, such as philosophers have already dreamt of.

I care not what the end may be. I do care that the inquiry shall be conducted by us, and that we shall be free from the disgrace of jogging along accustomed roads, leaving to outsiders the work, the ridicule, and the gratification of unfolding a new region to unwilling eyes.

It may be held that such investigations are not physical and do not concern us. We cannot tell without trying. In that I trust my instinct: I believe there is something in this region which does concern us as physicists. It may concern other sciences too. It must, one would suppose, some day concern biology; but with that I have nothing to do. Biologists have their region, we have ours, and there is no need for us to hang back from an investigation because they do. Our own science of physics, or natural philosophy in its widest sense, is the king of sciences, and it is for us to lead, not to follow.

And I say, have faith in the intelligibility of the universe. Intelligibility has been the great creed in the strength of which all intellectual advance has been attempted, and all scientific progress made.

At first things always look mysterious. A comet, lightning, the aurora, the rainbow—all strange, anomalous, mysterious apparitions. But scrutinized in the dry light of science, their relationship with other better-known things becomes apparent. They cease to be anomalous; and though a certain mystery necessarily remains, it is no more a property peculiar to them, it is shared by the commonest objects of daily life.

The operations of a chemist, again, if conducted in a haphazard manner, would be an indescribable medley of effervescences, precipitations, changes in color and in substance; but, guided by a thread of theory running through them the processes fall into a series, they all become fairly intelligible, and any explosion or catastrophe that may occur is capable of explanation too.

Now I say that the doctrine of ultimate intelligibility should be pressed into other departments also. At present we hang back from whole regions of inquiry, and say they are not for us. A few we are beginning to grapple with. The nature of disease is yielding to scrutiny with fruitful result; the mental aberrations and abnormalities of hypnotism, duplex personality, and allied phenomena, are now at last being taken under the wing of science after long ridicule and contempt. The phenomenon of crime, the scientific meaning and justification of altruism, and other matters relating to life and conduct, are beginning, or perhaps are barely yet beginning, to show a vulnerable front over which the forces of science may pour.

Facts so strange that they have been called miraculous are now no longer regarded as entirely incredible. All occurrences seem reasonable when contemplated from the right point of view, and some are believed in which in their essence are still quite marvellous. Apply warmth for a given period to a sparrow's egg, and what result could be more incredible or magical if now discovered for the first time. The possibilities of the universe are as infinite as is its physical extent. Why should we grope with our eyes always downward, and deny the possibility of everything out of our accustomed beat.

If there is a puzzle about free-will, let it be attacked: puzzles mean a state of half-knowledge. By the time we can grasp something more approximating to the totality of things the paradoxity of paradoxes drops away and becomes unrecognizable. I seem to myself to catch glimpses of clews to many of these old questions, and I urge that we should trust

consciousness, which has led us thus far; should shrink from no problem when the time seems ripe for an attack upon it, and should not hesitate to press investigation, and ascertain the laws of even the most recondite problems of life and mind.

What we know is as nothing to that which remains to be known. This is sometimes said as a truism; sometimes it is half doubted. To me it seems the most literal truth, and that if we narrow our view to already half-conquered territory only, we shall be false to the men who won our freedom, and treasonable to the highest claims of science.

I must now return to the work of this section, from which I have apparently wandered rather far afield, further than is customary—perhaps further than is desirable. But I hold that occasionally a wide outlook is wholesome, and that without such occasional survey, the rigid attention to detail and minute scrutiny of every little fact, which are so entirely admirable and are so rightly here fostered, are apt to become unhealthily dull and monotonous. Our life-work is concerned with the rigid framework of facts, the skeleton or outline map of the universe: and, though it is well for us occasionally to remember that the texture and color and beauty which we habitually ignore are not therefore in the slightest degree non-existent, yet it is safest speedily to return to our base and continue the slow and laborious march with which we are familiar and which experience has justified. It is because I imagine that such systematic advance is now beginning to be possible in a fresh and unexpected direction that I have attempted to direct your attention to a subject which, if my prognostications are correct, may turn out to be one of special and peculiar interest to humanity.

AMONG THE PUBLISHERS.

RUFUS C. HARTMANFT, Philadelphia, has prepared a little book which he will publish under the title "Was Abraham Lincoln a Spiritualist?"

—D. C. Heath & Co., Boston, will issue this month Victor Hugo's "Hernani," edited by John E. Matzke, associate in Romance languages, Johns Hopkins University.

—Max O'Rell's new volume of travels, called "A Frenchman in America," will be published by the Cassell Publishing Company, New York, late in October. In this book he gives the humorous side of his experiences as a lecturer, and he has a good deal to say about the people whom he has met, both the interesting and uninteresting ones. Mr. E. W. Kemble has made over 135 illustrations for the book.

—Now that the time of year has arrived when, according to popular tradition, "oysters are in season," every lover of that choice sea-food should be provided with a copy of Professor William K. Brooks's book, "The Oyster: a Popular Summary of a Scientific Study," recently published by the Johns Hopkins Press of Baltimore. The book is intended for all who care for oysters, whether providers or consumers; oystermen, law-makers, or students. Of it President Gilman of the Johns Hopkins University says, in a brief note of introduction to the volume, "So well is the book written that many parts of it are as fascinating as a story."

—J. B. Lippincott Company will publish immediately: "Harmony of Ancient History and Chronology of the Egyptians and Jews," by Malcolm Macdonald; "The Natural History of Man and the Rise and Progress of Philosophy," a series of lectures delivered by Alexander Kinmont; and "Truth-Gleams," a series of essays on the controlling influences in life. Among the new publications to be issued late in the month are: "A Supplement to Allibone's Dictionary of Authors," in two volumes, by John Foster Kirk; "A Handbook of Industrial Organic Chemistry," by S. P. Sadtler, and "Atlantis Arisen; or, Talks of a Tourist about Oregon and Washington," by Mrs. Frances Fuller Victor.

—Those who have profited by the study of Verschoyle's "History of Ancient Civilization" will be gratified to learn that Messrs. D. Appleton & Co. are about to publish a volume which may be called a pendant or supplement of Verschoyle's work. This is "A History of Modern Civilization," a handbook based on Gustav Ducoudray's history. In this book "the author and adapter," according to a London critic, "have reached one of the rarest results in literary work, a summary at once comprehensive and readable."

—L. Reeve & Co., London, have in preparation a new work on the "British Fungi Phycomicetes and Ustilagineæ," by George Massee, lecturer on botany for the London Society for the Extension of University Teaching; a work on the British "Hemiptera Heteroptera," by Edward Saunders; a new work on the Lepidoptera of the British Islands, by Charles G. Barrett; and a new work on the "Physiology of the Invertebrata," by Dr. A. A. Griffiths.

—The *Chautauquan* for October has several illustrated articles and the portraits of a number of prominent women. Of the articles we note "Domestic and Social Life of the Colonists," I., by Edward Everett Hale; "Land Tenure in the United States," by D. McG. Means; "The History of Political Parties in America," by F. W. Hewes; "Physical Life," I., by Milton J. Greenman; "National Agencies for Scientific Research," by Major J. W. Powell; "Science, the Handmaid of Agriculture," by George

William Hill; "Social Science in Society," by John Habberton; "The Bohemians in America," by Thomas Capek; and "The Citizenship of Crime," by Mrs. Kate Tannatt Woods.

—T. Y. Crowell & Co. have just ready, among other books, their new edition of Charles Dickens' complete works in fifteen and thirty volumes; "Making the Most of Life," by Rev. J. R. Miller, D.D.; "A Score of Famous Composers," by Nathan H. Dole; "Famous English Statesmen," by Mrs. Sarah K. Bolton; and the fourth volume of Sybel's "The Founding of the German Empire" by William I."

—The present condition of the peasants in the Russian empire is the subject of a paper submitted by Vicomte Combes de Les-trade to the American Academy of Political and Social Science and published by the Academy. Every one remembers the enthusiasm which greeted the emancipation of the serfs by Alexander II. in 1861. The author of this monograph holds that he deserves credit for what he wished to do rather than for what he did. It is somewhat startling to be told by one who speaks from careful personal observation of the existing conditions that the authority of which the Seigneurs were stripped has only been transferred to the *mir*. This word and the system for which it stands are absolutely new to us. The author explains its organization and practical working, and recites the peculiar conditions under which the peasant is allowed to withdraw from the *mir* to which he belongs. The paper gives a sketch of the actual char-

Publications received at Editor's Office,
Sept. 2-15.

- HOWARD, C. R. The Transition-curve Field-Book. New York, Wiley. 109 p. 16°.
KINMONT, A. The Natural History of Man. Philadelphia, Lippincott. 335 p. 12°. \$1.
NAVAL Progress, The Year's. Annual of the Office of Naval Intelligence; July, 1891. Washington, Government. 491 p. 8°.
RAILWAY Law and Legislation. A weekly magazine of information regarding laws, etc. Vol. I. No. 1. w. Washington, D. C., Canaday & West. 20 p. 8°. \$3 per year.
SMITH, S. A. The Source and Nature of Electricity, and Its Application to the Electro-Plating Process. Providence, Gorham M'fg Co. 35 p. 12°.
THURSTON, R. H. A Manual of the Steam-Engine. Part I. Structure and Theory. New York, Wiley. 871 p. 8°. \$7.50.

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—According to the *Japanese Gazette*, printed in Yokohama, "during the month of June there were 5,575 persons who took books from the Tokyo Free Library, nearly all of them in the Japanese and Chinese languages. Among the 36,687 volumes drawn, 7,482 were books of history, biography, and geography, 6,753 of law and politics, 6,600 of literature and language, 5,877 of natural philosophy and medicine, 4,174 of engineering, the arts, and industries, 2,087 of philosophy and education, and the rest were of a miscellaneous kind."

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